



**LITERATURE REVIEW OF RAINBOW TROUT IN THE HENRYS FORK  
OF THE SNAKE RIVER, IDAHO**

**By:**

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## BACKGROUND

The Henrys Fork of the Snake River between Island Park Reservoir and Ashton Reservoir has long been a famous rainbow trout fishery. The area has also become a popular wintering area for waterfowl, particularly trumpeter swans. By the late 1980s, Harriman State Park had become the most important wintering site for the Rocky Mountain Population of trumpeter swans (Figure 1) (Shae 1993). Duck and goose winter use has also increased. Waterfowl on the Henrys Fork typically select low gradient areas, which tend to have an associated high abundance of aquatic macrophytes. The aquatic macrophytes are a forage base for wintering waterfowl (Shae 1993).

Congregations of waterfowl were great enough in recent years to overgraze the aquatic plant communities (Kadlec 1991). These events occurred at the peak of drought conditions and at the peak of the trumpeter swan population wintering at Harriman State Park (Shae 1993). The result was a change in the species composition and abundance within the aquatic plant community (Kadlec 1991; Shae, personal communication).

The aquatic plant community was dominated by perennial species. Perennial species, such as water milfoil *Myriophyllum exalbescens*, *Ranunculus aauatillis*, and elodea *Elodea canadensis*, are of key importance to the hydrology of the river because they do not senesce in winter (Kadlec 1991). The dense mats that they form serve to impede flows, slow velocities, and increase depth and channel volume (Shae 1992). Waterfowl grazing has effected the perennial plants, and they have been replaced in some areas by annual species. Annual species, suspected to be pioneer species (Kadlec 1991) such as *Zanichellia spp.* and *Callitriche spp.*, have become increasingly abundant in recent years. These two plants are sometimes called the "cheat grass" of the aquatic world (Shae, personal communication, 1993). These alterations in the aquatic macrophyte community have impacted the hydrology of the river by increasing velocities and decreasing depth and channel volume (Vinson 1992; Vinson et al. 1992) (Figure 2). The Henrys Fork has a unique hydrologic regime, in that the water depth and channel volume in the low gradient reaches are driven by the density of aquatic macrophytes (Shae, personal communication).

## THE PROBLEM

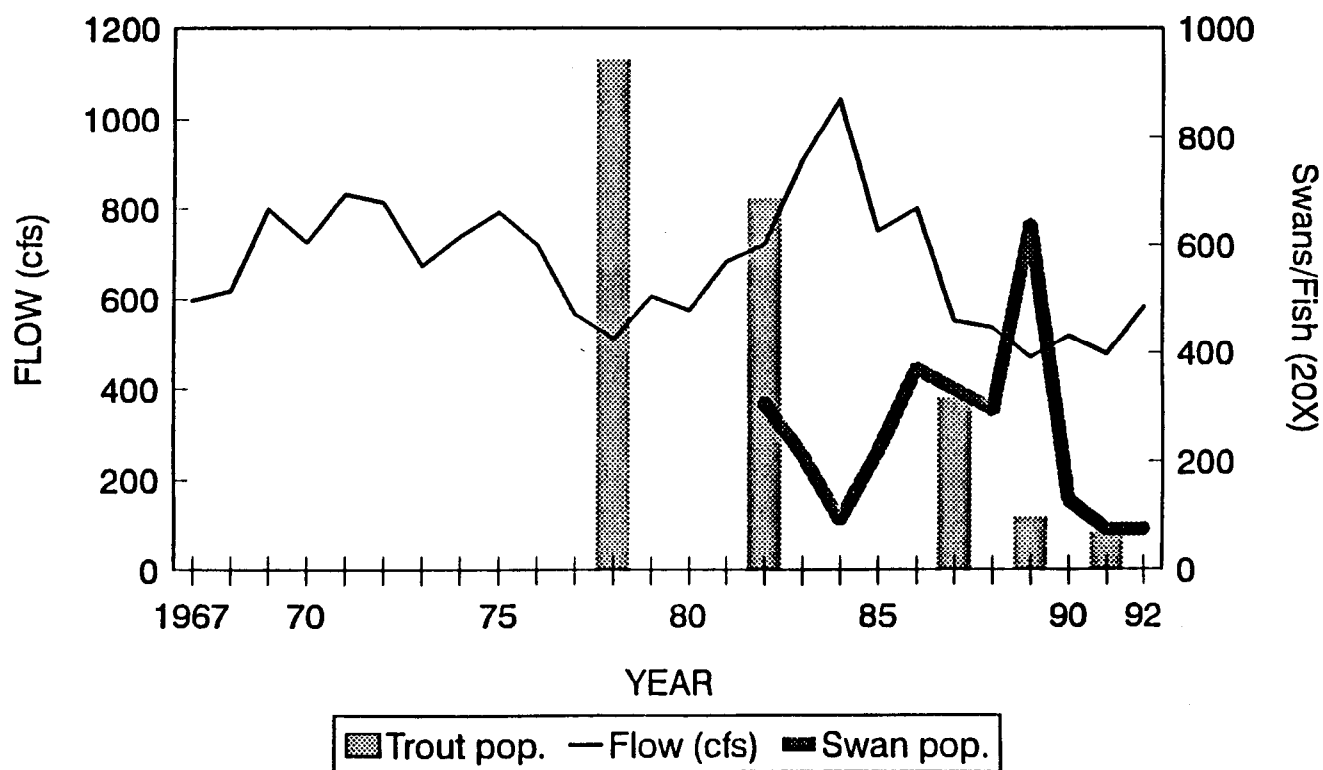
The rainbow trout population in the Henrys Fork of the Snake River has steadily declined over the past 15 years (Figure 3). Why has this decline occurred? I summarized historical information that may have played an important role in the decline?

## THE SYSTEM

This paper focuses on the section of the Henrys Fork from Island Park Dam downstream roughly 13 kilometers to the lower boundary of Harriman State Park. The area shall be divided into three sections for description: Box Canyon, Last Chance, and Harriman State Park.

Box Canyon is immediately below Island Park Dam, receiving flows from both the Dam and the Buffalo River. This is a high gradient (.4%) erosional type channel with large substrate. Both sides of the river are lined with trees, boulders, and basalt cliffs. Aquatic macrophytes in this reach were not abundant, and were only found along the margins in depositional areas (Contor 1989). Box Canyon extends 5.2 kilometers in length.

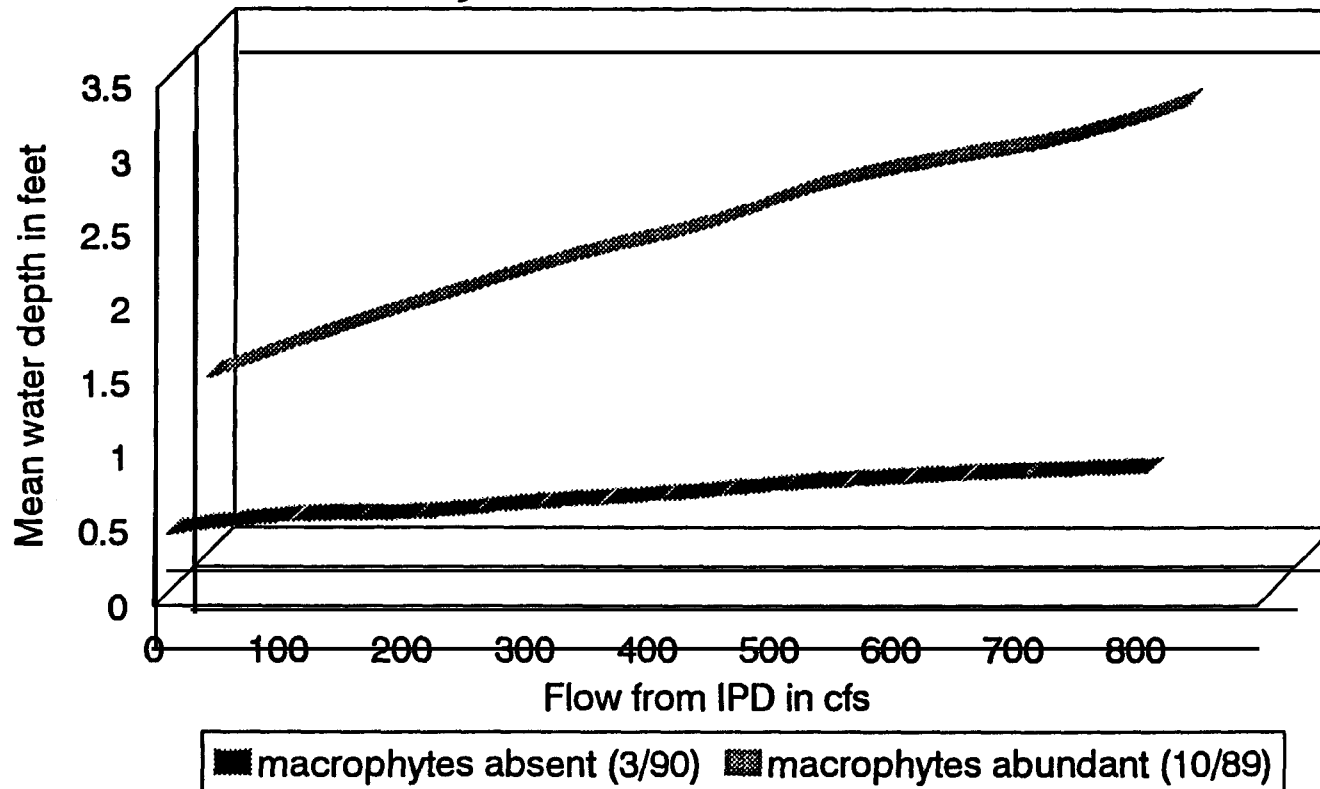
# A Comparison of Henrys Fork trout and swan populations and mean flow



Trout larger than 10 inches (2 years & older)

Figure 1. Comparison of rainbow trout (>10 inches) and swan populations with mean flow on the Henrys Fork below Island Park Dam.

# Aquatic Macrophyte Densities and Water Depths in the Henry's Fork at Harriman State Park



From: Ruth Shae, unpub. data, 1993.

Figure 2. Aquatic macrophyte densities and water depths in the Henrys Fork at Harriman State Park.

# Box Canyon Wild Rainbow Population Estimates

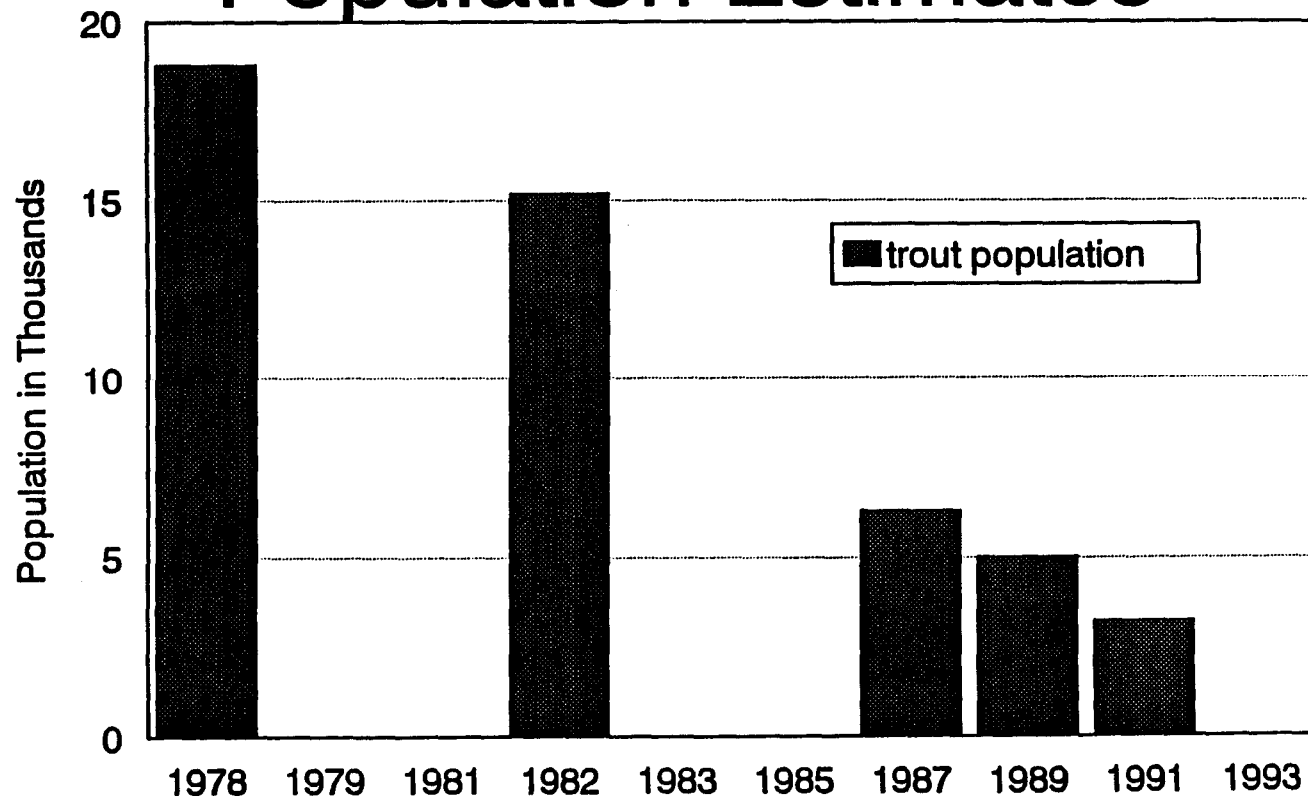


Figure 3. For fish over 250 mm in length.

Figure 3. Box Canyon wild rainbow population estimates for fish over 250 mm in length.

Last Chance begins at the lower end of Box Canyon and extends downstream 1.8 kilometers to the upper boundary of Harriman State Park. This stretch is a transition from high gradient to low gradient (.3%). Last Chance is wider than Box Canyon. The substrate in Last Chance is mostly cobble and gravel with some boulder clusters along the shore. Aquatic macrophytes were abundant in the past, but my 1993 observations showed an impacted plant community in the early stages of recovery.

Harriman State Park is a low gradient (.12%) depositional type section characterized by smaller substrate. The channel is very wide, and Contor (1989) noted an abundance of dense aquatic macrophyte beds over embedded gravel substrates. These macrophytes were also impacted and in the early stages of recovery based on my 1993 observations. The banks of both Last Chance and Harriman State Park show signs of livestock impacts.

### AQUATIC MACROPHYTES

Density and abundance of aquatic macrophyte beds are the most important controlling factors of water depth and channel volume in the Henrys Fork. The occurrence and abundance of submersed aquatic macrophytes are determined by four factors: light, nutrients, mechanical effects (waves, currents, etc.), and herbivory (Kadlec 1991). Herbivory is the most obvious and important impact to macrophytes in the Henrys Fork. Waterfowl feed on both the above ground and underground structures of these plants. The amount of above ground biomass of these plants directly effects the hydraulics of the river (Vinson et al. 1992). Dense macrophyte beds dramatically impede water movement, which results in lower average cross-sectional velocities and greater depth at a specified flow volume (Figure 2) (Kadlec 1991). When aquatic macrophyte densities decrease, average flow velocities increase and depth decreases (Vinson 1991). When depth decreases, channel volume also decreases, which usually results in dewatered shoreline habitat. The underground macrophyte structures are responsible for maintaining the perennial nature of these critical plants, since they regenerate vegetatively rather than by seed. Reestablishment of the aquatic plants has become increasingly difficult because increased velocities with larger substrates are unsuitable for establishment, growth, and survival, as are areas that are periodically dried. Thus, loss of macrophytes sets in motion a set of environmental changes which make recovery slow and difficult (Kadlec 1991).

Shae (1993) and Kadlec (1991) have provided the following brief chronology of the decline in aquatic macrophyte abundance:

- |                  |   |
|------------------|---|
| * 1987-88 winter | Heavy ice cover on the river.   |
| * 1988 summer    | Macrophytes abundant.   |
| * 1988-89 winter | Heavy ice cover on the river, drought extreme, many swans starving.     |
| *-1989 February  | Emergency flows released from Dam to break the ice so swans could feed. |
| * 1989 summer    |   |
| * 1989-90 winter | No data.  |
| * 1990 summer    | Low ice cover due to mild weather, many waterfowl wintering.            |
|                  | Huge decrease in plant density.   |

- \* 1990-91 winter Heavy ice cover, many swans, trapping/relocation begins.
- \* 1991 March Little aquatic vegetation.
- \* 1991 summer Some vegetation recovery.

The Rocky Mountain Population of Trumpeter Swans were in need of dispersion. Biologists began trapping and relocating swans during the winter of 1990-91. This was an effort aimed at expanding their migration range. The swans had become dependent on Harriman State Park and Red Rock Lakes National Wildlife Refuge as a primary wintering area. In this area, where hunting is prohibited, use by wintering waterfowl increased in the late 1980s. Collectively, swans, ducks, and geese contributed to the overgrazing of aquatic plants in the Harriman/Last Chance area. When swans started grazing in an area, the depth decreased (as a result of the loss of vegetation), which made more vegetation accessible to themselves, as well as ducks and geese.

Waterfowl dispersal, in order to reduce herbivory, was essential. The simplest method (aside from hunting pressure, which is not a viable option) would be to allow the birds to eat themselves out of house and home. This would force the birds to disperse. This option was not selected because of fisheries interests (Shae, personal communication, 1993). It should also be mentioned that ice cover on the river prevents herbivory. Hazing waterfowl, as a substitute for hunting pressure, was implemented along with the range expansion efforts. Trapping/relocation and hazing have been successful so far (Shae 1993). The number of wintering swans in the area had decreased from 750 in 1990 to about 250 in 1992 (Figure 1).

#### FISH ECOLOGY AND MANAGEMENT

The rainbow trout population in the Henrys Fork has declined during the 1980s according to electrofishing data from Idaho State University and the Idaho Department of Fish and Game (Coon 1978; Rohrer 1984; Angradi and Contor 1989; and Gamblin et al. 1993). Fish populations for Box Canyon were estimated to be 18,800 in 1978, 15,200 in 1982, 6,300 in 1987, 5,000 in 1989, and 3,200 in 1991 (Figure 3). The estimates could be decreasing for any of the following reasons: 1) fishing-related mortality has increased, 2) fish have moved out of the area, 3) recruitment has been adversely impacted, or 4) natural mortality has increased. We will define recruitment as being fish that survived 250 mm. Overharvest is unlikely because the regulations for the Box Canyon to Harriman State Park sections have reduced or eliminated harvest since 1978 (Table 1) (Coon 1978; Rohrer 1981, 1983, 1984; Angradi and Contor 1989). No conclusive data showed any migration of fish out of this section of the Henrys Fork (Angradi and Contor 1989). Evidence indicates that recruitment, in the form of juvenile overwinter survival, has been adversely impacted. Winter trout behavior, habitat, and survival have been studied extensively (Contor 1989; Smith 1992; Riehle 1990; Angradi and Contor 1989; Angradi 1990, 1992; Swales et al. 1986; Tschaplinski and Hartman 1983; Maciolek and Needham 1951; Hillman et al. 1987; Hartman 1963; Heifetz et al. 1986; Cunjak 1988; Cunjak and Power 1986, 1987; Bustard and Narver 1975; Campbell and Neuner 1985).

Young-of-the-year trout that survive their first summer face extreme challenges. The current management of Island Park Dam, adverse storage for irrigation purposes, calls for flows to be cut to roughly 100 cfs between September 15 and November 15. This time frame coincides with the rapid onset of winter conditions in Island Park. Early winter is a stressful period of

acclimation to rapidly changing conditions (Cunjak 1988). Juvenile fish must cope with rapidly changing water temperatures and, consequently, rapidly changing metabolisms (Riehle 1990). These changes can ultimately lead to a significant decrease in body condition, which in turn can effect survival (Cunjak and Power 1986).

Juvenile rainbow trout exhibit behavioral changes to accommodate these conditions. Daytime hiding behavior was adopted when water temperatures dropped below 8°C (Contor 1989). Close association of juvenile trout with concealment cover was consistently reported (Rimmer et al. 1983; Bustard and Narver 1975; Angradi and Contor 1989). Concealment cover, as described by Contor (1989) and Riehle (1990), included unembedded boulder clusters, undercut banks, and flooded willows near shore. Contor (1989) reported that rarely were juvenile trout found using dense aquatic macrophyte beds as concealment cover. He stated one case where four juvenile trout were using these beds as concealment cover where a nearby boulder cluster had been dewatered.

Daytime use of concealment cover is accepted as being a behavioral adaptation to minimize risk of predation (Angradi and Contor 1989; Contor 1989; Cunjak and Power 1986; Campbell and Neuner 1985; Bustard and Narver 1975; and Smith 1992), to avoid physical harm from ice formation and shifting (Needham and Jones 1959; and Smith 1992), and minimize energy expenditure (Contor 1989; Cunjak and Power 1986; Campbell and Neuner 1985; Tschapinski and Hartman 1983; Bustard and Narver 1975). Risk of predation does not vary seasonally, therefore use of daytime concealment cover in response to risk of predation should not vary seasonally (Smith 1992). However, use of daytime concealment cover does vary seasonally, so it seems unlikely that its use is in response to predation risk. Physical damage caused by ice formation and shifting has been noted as a possible source of winter mortality for trout in rivers (Smith 1992). Physical damage may include suffocation caused by dewatering of stream sections when anchor ice dams form; dewatering of side channels when ice dams break; or when snow and ice collapses and crush or suffocate fish (Needham and Jones 1959). Boulder and cobble substrate may provide adequate protection from physical harm.

Winter daytime use of concealment cover also aids juvenile fish in minimizing energy expenditure and maximizing energy acquisition (Contor 1989). Fish emerge from the substrate after dark to feed in adjacent areas of low velocity, presumably using the darkness as cover. This emergence has been negatively correlated with light intensity. Contor (1989) postulates that the evolution of winter daytime hiding and nighttime feeding behavior is a result of such stress mechanisms as risk of predation, temperature related decrease in swimming ability, metabolism, digestion, and feeding.

Smith (1992) stated that the interstices of the substrate concealment cover may function as a thermal refuge in addition to the above mentioned attributes. He reported finding somewhat warmer water temperatures within boulder clusters than in the water column. Cunjak and Power (1986) noted fish aggregating near springs and groundwater seeps, as they were warmer than the main stream proper. Ice cover also insulates the water column. Ice reduces heat loss to ambient air currents. Use of warmer waters would increase fish metabolism, digestion, efficiency of nutrient assimilation, and allow fish to maintain body condition without having to rely as heavily on lipid reserves (Smith 1992; Cunjak 1988). This would lead to better survival.

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